Storm and Sanitary SelectCAD

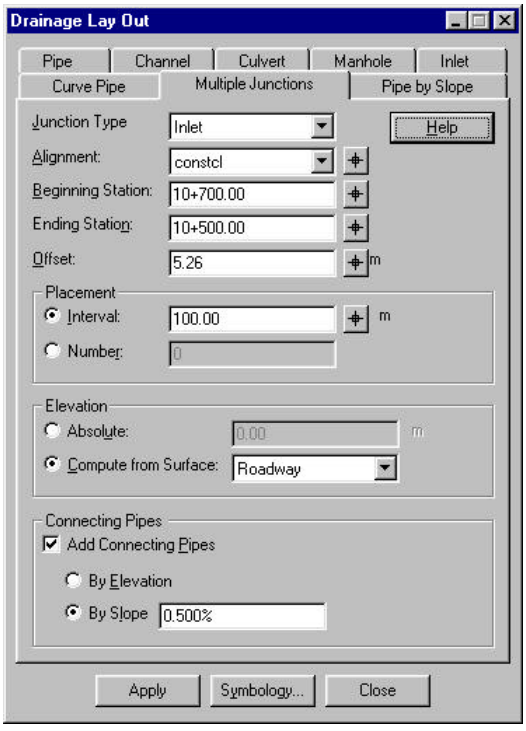
Storm & Sanitary SelectCAD is the tool chosen by MCDOT for storm water and sanitary sewer design. With Storm & Sanitary SelectCAD, MCDOT can design new networks or expand existing networks using the interactive modeling capabilities, profiling capabilities, and design/analysis tools of the software. MCDOT may also customize reports from the design data stored in the software database. This chapter is intended as an overview of some of the Storm & Sanitary SelectCAD package capabilities. Inlet design, pipe design and profiles are covered, as well as a brief look at reports and roadway drainage. The convention is an example workflow to walk the user through a typical project. Various workflows can be easily modified to meet the needs of a specific project. Please see Volume I, CADD Drafting standards and Volume II, CADD Design standards for layering conventions, naming conventions, etc., for items addressed in this chapter.

Place New Inlets and Pipes

- Multiple Junctions

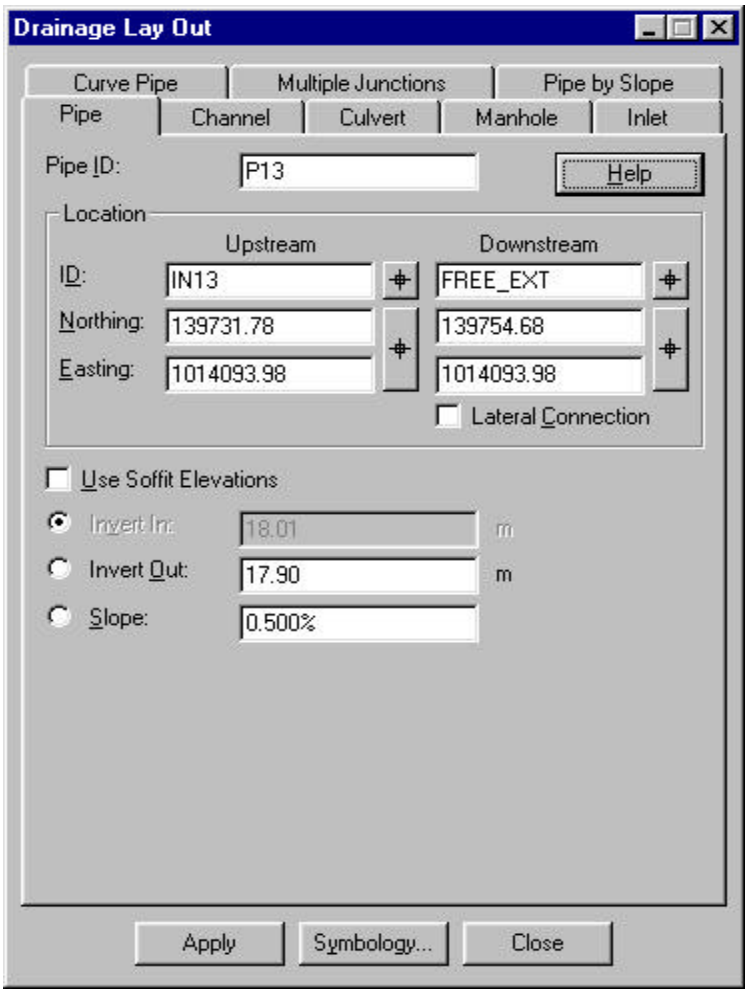
When laying out multiple inlets or manholes, and the use of connecting pipes between these features is needed, the Multiple Junction option is used.

Select **Drainage>Lay Out**. This command will display the dialog for laying out pipes, channels, culverts, manholes, and inlets. Choose the **Multiple Junctions** tab. Add the project-specific information in the respective setting box, or choose interactively by using the locator button at the right of the settings box.



In the preceding example, three inlets and two pipes are joined along the **PipeCL01** alignment at an offset of 5.26m from station 10+700 to station 10+500.

- Select the **Pipe** tab in the drainage lay out dialog box.

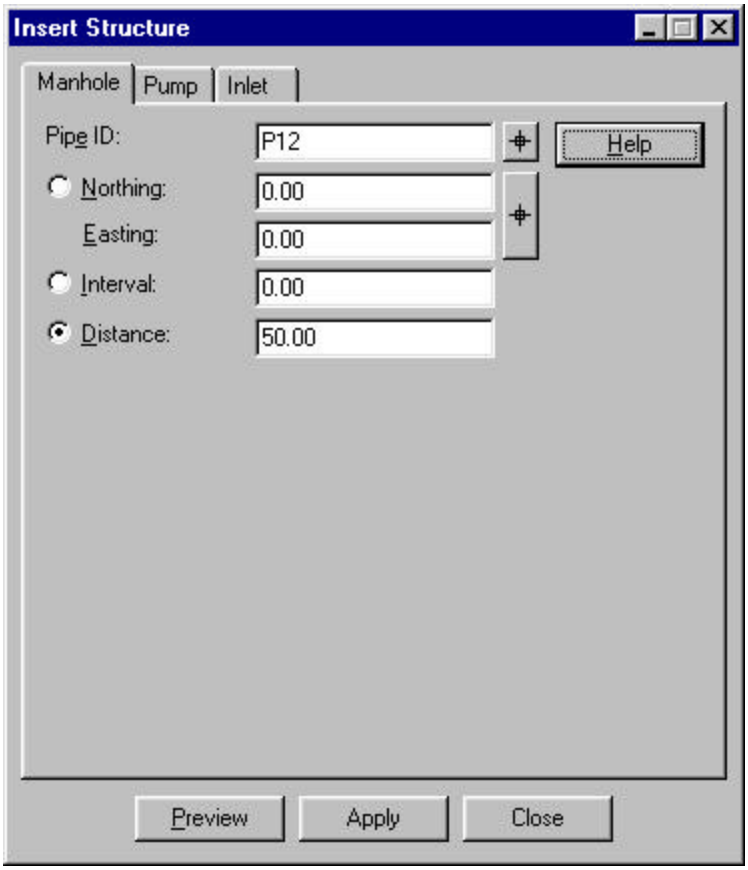


Insert the appropriate information and select **Apply**. By using the preceding example, a pipe would be connected to the last inlet and the flow would be diverted to the north.

The following steps demonstrate how to insert a manhole between the last two inlets and move the manhole such that the pipes are closer to the road's centerline. Close the Lay Out dialog and select **Drainage>Structure>Insert**. The Insert Structure dialog box will open. This dialog box is used for the insertion of a manhole, a pump, or an inlet.

Select the manhole tab, and identify the pipe needed by either typing in the **Pipe ID** or using the locator button to select the correct pipe.

This example places the manhole halfway between the inlets. Since the pipe is 100 meters long, place the manhole at a distance of 50 meters from the end of the pipe. The distance is measured from the beginning stationing of the pipe.



You may preview your selection by clicking **Preview**. When satisfied with the results, click **Apply**. A manhole is placed midway along the pipe by inserting another junction in the network. The pipe is divided creating a new pipe and is shown as part of the network.

To move the manhole, select **Drainage>Structure>Move**. The Move Structure dialog provides several options for how to adjust the structure's location. Choose the following toggles for this example.

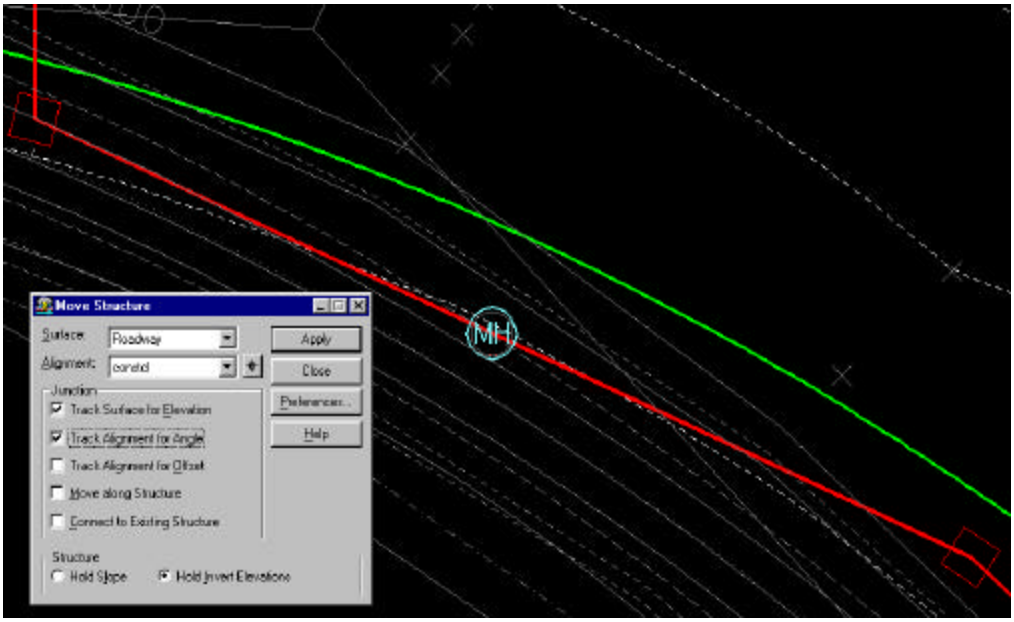
Surface: Roadway

Alignment: PipeCL01

Track Surface for Elevation

Trace Alignment for Angle

Hold Invert Elevations



Select **Apply**. You will be asked to identify the structure you want to move. Choose the manhole and move it north to the inside of the Roadway surface.

Click an appropriate location to place the manhole.

Design Inlets

Storm & Sanitary SelectCAD is based on HEC-22 calculations. This section shows you how to design specific inlets. The first step in designing the new network is to inject flow into the system.

Select **Drainage>Edit/Review**, then select the first inlet that was laid out.

At the top of the dialog are several tabs that detail design parameters for the inlet. Click on the **Flow** tab. The setting on this tab allows for the modification of flow. For this example, change the setting to 0.05 m^3/s and select **Apply**. The change is now updated in the network.

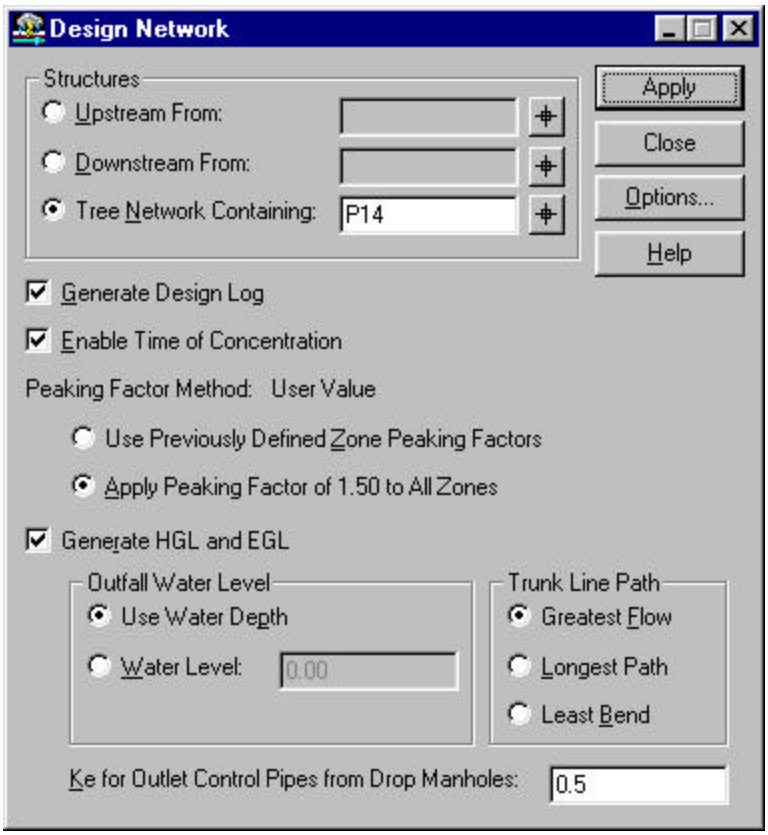
Return to the **Inlet** tab and click **Edit Down**. This advances the **Edit/Review** dialog to the next downstream structure in the network. In this case, the next downstream structure is a pipe.

Ensure that the structure status is set to **Resize** . This allows the pipe to be resized as needed during the design process. If the pipe already existed and did not need replacing, **Fixed** would be the more appropriate choice.
Again, click **Edit Down**. Repeat this process of modifying the injected flow for the remaining inlets and pipes and ensuring that the manhole is set to be resized.

To design the network, select **Drainage>Network>Design**.

Designing a network can be done upstream or downstream from a particular structure or the entire network containing a particular structure. In this example, set the following:

- Tree Network Containing: Any structure in the network. This will also enable HGL and EGL calculations.
- Generate Design Log.
- Enable Time of Concentration.
- Apply peaking factor of 1.50 to all zones.
- Generate HGL and EGL using Water Depth and the Greatest Flow Trunk Line Path.



Select **Apply**. The network will be designed accordingly and redisplayed to reflect new sizes. Once the calculations are finished, the design log will be displayed for your review. Notice the HGL and EGL calculations at the bottom of the design log. These calculations can be used to review the design.

Profile and Modify the System

The next few steps demonstrate the process of showing the profile of the network created in the previous example, and how you may modify it inside the profile window.

Select **Evaluation>Profile>Create Profile**.

Set the following settings:

- Create **Window** and **Data**. This creates a new profile window with the data you choose to include inside it. In addition to this option, you may choose to create a blank profile window or add only data into an existing profile window. Data only is used for projecting a drainage profile to a profile of a horizontal alignment.
- In the surface box, select both **Roadway** and **Survey**. The profile will draw a surface line for both surfaces.
- Select **Network** in the source section. This enables the Network Structures section.
- In the Network Structures section, from our example choose the first inlet created to the last pipe created.
- Select **Apply**. The window minimizes and allows you to place the profile in the drawing file.
- Select a location for the profile. The profile for the selected structures is then placed at this location.
- Close the **Create Profile** dialog.

A closer look at the profile will show you the hydraulic and energy grade lines above the pipes. The inlets and manhole are also placed in the profile. Assuming that modifications to the network are required, the following process will aid with these modifications.

Zoom into the profile window such that all the structures can easily be seen.

Select **Drainage>Structure>Move in Profile**. With this command, you can select a drainage structure to be moved inside the profile window. This is demonstrated in the following example:

- Select a pipe near the location where it connects to an inlet or a manhole. The invert at the end of the pipe you selected will change along with the slope of the pipe. A similar process is used for the opposite end of the pipe. Cancel the command.

- Select a pipe, but this time, select it near the center of the pipe. Both inverts are adjusted while the slope of the pipe is maintained. Cancel the command.

- Select an inlet or a manhole. The elevation of the structure is changed, and so is the slope of the adjoining pipes. Cancel the command.

- Move the structure of your choice, possibly changing the slope of a connecting pipe. Accept the new placement.

Whenever the network has been changed, the design must be updated to reflect the changes. Select **Drainage>Network>Design**. The previous settings should still be present. Select **Apply**, then review and close the design log.

A new profile is not necessary; just update the one that is already present. To do this, select **Evaluation>Profile>Update Drainage Profile**.

You will be given the option to update one profile or all profiles. Choose your selection and select **Apply**.

If you chose to update a single profile, you must select which profile is to be updated. Once done, the new design parameters will be shown in the updated profile(s).

Next, select **Evaluation>Profile>Annotate Drainage Profile**. The default preferences are loaded and can be modified. You may change what is annotated and how it is annotated for each structure type.

Select **Apply**. Similar to the Update Drainage Profile command, you may choose to annotate one profile or all profiles.

Once the profile is annotated, click on **Preferences**.

Choose **90deg** and load the preference settings. This preference is set up to annotate the invert elevations.

Once you have loaded the new preferences, close the Preferences dialog and apply the annotation as you did earlier.

Reports

The original network that you may have seen while working through these steps is ready for design. The major difference between the network you designed and the original one is the method used to inject flows into the system. If you view the drainage networks and the **"Area"** option is turned on, small areas are shown near the original network. Similar areas may be created with MicroStation. Runoff flows for each area may be calculated by selecting **Drainage>Flows>Compute Flow**. The area will become a drainage structure in the drainage database file. The flows from the area may be attached to certain drainage structures. The same process may be used to compute zones for sanitary systems.

Another useful feature in Storm & Sanitary SelectCAD is the ability to query on specific drainage structures and modify or report on that particular selection. Some queries are already ready to use. For a brief review of this functionality, please do the following:

Select **Tools>Drainage>Queries**.

By default, the structure type is set to "**Pipes**" and the query is set to "**All ³ P1**." Click **Apply**. Applying this query selects all pipes that have a structure ID that is greater than or equal to P1. If a pipe exists in the database that is labeled Pipe1, it will not apply to this query.

Once the pipes are selected, properties of all these pipes may be defined at one time by selecting **Modify Attributes**.

Select an attribute to be modified and the appropriate operator and value. For instance, to change the roughness coefficient for all pipes, select "Roughness" for the attribute, "=" for the operator, and type a new roughness coefficient for the value.

Click **Add** and then **Apply**. All roughness coefficients for all the pipes are then modified to the new value.

Roadway Drainage Design

Storm and Sanitary SelectCAD has many civil engineering drainage design capabilities including:

- Accessing the project **.DTM** file to create drainage areas.
- Computing the flow generated from drainage areas based on such parameters and methods as:
    - Rainfall
    - Time of concentration
    - Frequency
    - Runoff coefficient
    - Peak flow
    - Intensity
    - FAA (method for calculating time of concentration)
    - Kirpich (method for calculating time of concentration)
- Sizing inlets and pipes based on these drainage areas.

With all the tools available to MCDOT, generating accurate drainage calculations is much simpler. With a minimum of setup, an engineer is able to quickly and easily create a sophisticated drainage network for any MCDOT drainage design project. Placing and sizing inlets and pipes automatically, calculating flows, calculating drainage areas, profiling, and placing all of this information on plan sheets can dramatically reduce drainage engineering time and costs.